

Mushroom

Franciszek Adamicki

Adamicki is with the Department of Vegetable Storage, Research Institute of Vegetable Crops, Skierniewice, Poland.

Scientific Name and Introduction

Mushrooms (*Agaricus bisporus* (Lange) Sing.) (button mushrooms) are cultivated worldwide. Highest production is in the United States, China, France, Holland, United Kingdom, and Poland. They are eaten fresh in salads or as a cooked vegetable. A large volume is canned.

Quality Characteristics and Criteria

Quality is based on maturity, size, trimming, freedom from open veils, disease, spots, insect injury and decay. A uniform, well-rounded cap with a smooth, glossy surface and fully intact veil indicate high quality. The cap should be white or dark brown. Lack of growth medium on caps and absence of browning or other discoloration are also quality factors. Visible open caps and absence of a stipe are negative factors.

Horticultural Maturity Indices

Mushrooms are harvested by maturity, not by the size of the caps. Proper maturity is reached when the caps are well rounded and the partial veil is completely intact. The stipe should have a small length:thickness ratio and should be sufficient to permit some trimming without cutting caps.

Grades, Sizes, and Packaging

U.S. grades are No. 1 and No. 2. Sizes are Small (button), 1.9 to 3.2 cm (0.75 to 1.25 in); Medium, 3.2 to 4.5 cm (1.25 to 1.8 in); and Large, >4.5 cm (1.8 in), measured as cap diameter. Grades discriminate for maturity, shape uniformity, cleanliness, and trim quality. Mushrooms are packed in trays or cartons with a perforated polyethylene film overwrap (Suslow and Cantwell 1998).

Precooling Conditions

Mushrooms should be precooled to 2 to 4 °C (32 to 39 °F) immediately after harvest. Hydrocooling and forced-air cooling are often used. Freshly harvested mushrooms keep their quality longer throughout their shelf-life if immediately packed and vacuum-cooled and then transported at a low temperature. The same procedure is applied to cut mushrooms.

Optimum Storage Conditions

Mushrooms can be held for 7 to 9 days upon rapid cooling and storing at 0 to 1 °C (32 to 34 °F) with 95% RH. Storing at 2 °C (36 °F) shortens storage life to 3 to 5 days by accelerating surface browning, stipe elongation, and veil opening (Umiecka 1986). High RH is essential to prevent

desiccation and loss of glossiness. Moisture loss is correlated with stipe blackening and veil opening. Mushrooms should be packed in cartons with a perforated overwrap of polyethylene film to reduce moisture loss. It is important to avoid water condensation inside packages. There are no chemical treatments to extend storage life of mushrooms intended for fresh consumption.

Controlled Atmosphere (CA) Considerations

Mushrooms derive a moderate benefit from storage under 3 to 21% O₂ and 5 to 15% CO₂ (Saltveit 1997). A 3% O₂ and 10% CO₂ CA extends storage life to 12 to 15 days at 0 °C (32 °F) (Suslow and Cantwell 1998). A 10 to 15% CO₂ CA reduces cap opening, browning, and stipe elongation. Mushroom quality was maintained in 8% O₂ and 10% CO₂ (Zheng and Xi 1994). Storage under low O₂ and high CO₂ inhibits cap opening and internal browning but causes yellowing of the cap surface. Levels of O₂ <1% can favor growth of *Clostridium botulinum* and the development of off odors and off flavors, as well as cap opening and stipe elongation. For this reason, CA is not commonly used (Carrier 1995).

Retail Outlet Display Considerations

Mushrooms should be kept on refrigerated shelves at <4 °C (40 °F). Mushrooms absorb odors from green onions; they should not be transported or displayed together.

Chilling Sensitivity

Mushrooms are not chilling sensitive, but they freeze below -0.6 °C (31 °F). Freezing injury appears as water-soaked and extremely soft caps (Suslow and Cantwell 1998).

Ethylene Production and Sensitivity

Mushrooms produce very low amounts of ethylene: < 0.1 µL kg⁻¹ h⁻¹ at 20 °C (68 °F). Since ethylene causes browning of mushroom caps, they should be kept separate from ethylene-producing fruits and vegetables.

Respiration Rates

Temperature	mg CO ₂ kg ⁻¹ h ⁻¹
0 °C	28 to 44
5 °C	70
10 °C	97
15 °C	—
20 °C	240 to 288

Data from Suslow and Cantwell (1998).

To get mL CO₂ kg⁻¹ h⁻¹, divide the mg kg⁻¹ h⁻¹ rate by 2.0 at 0 °C (32 °F), 1.9 at 10 °C (50 °F), and 1.8 at 20 °C (68 °F). To calculate heat production, multiply mg kg⁻¹ h⁻¹ by 220 to get BTU ton⁻¹ day⁻¹ or by 61 to get kcal tonne⁻¹ day⁻¹.

Physiological Disorders

Low storage temperatures are needed to reduce continued development of mushrooms after harvest. Common disorders include upward bending of caps and opening of the veil. Mushrooms are easily bruised by rough handling and develop brown discolored tissue.

Postharvest Pathology

Disease is generally not an important source of postharvest loss in comparison with physiological senescence and improper handling or bruising. All diseased caps must be eliminated at harvest. Bacterial blotch or *Pseudomonas* spp. can become a problem during extended storage at elevated temperatures (Suslow and Cantwell 1998).

Quarantine Issues

None are known.

Suitability as Fresh-Cut Product

Fresh-cut mushrooms are becoming increasingly popular at the wholesale and retail level.

References

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